

THE additions to the Zoological Society's Gardens during the past week include an Arabian Baboon (*Cynocephalus hamadryas*) from Egypt, presented by Mrs. Locke King; two Tufted Umbres (*Scopus umbretta*) from Bechuanaland, South Africa, presented by Mr. F. J. Newton, C.M.G.; four Cockateels (*Calopsitta nove-hollandie*), a Many-coloured Parrakeet (*Psephenus multicolor*), a Rose-Hill Parrakeet (*Platycercus eximius*) from Australia, presented by Mr. Thomas J. Manns; two Red and Blue Macaws (*Ara macao*), five Saffron Finches (*Sycalis flaveola*), two Pileated Song Sparrows (*Zonotrichia pileata*), a Guttural Finch (*Spermophila gutturalis*), a Plumbeous Finch (*Spermophila plumbea*), a White-throated Finch (*Spermophila albogularis*), a — Finch (*Spermophila torquella*), a Black-throated Siskin (*Chrysomitris magellanica*) from South America, a Brambling (*Fringilla montifringilla*), a Greenfinch (*Ligurinus chioris*), European, presented by Mr. A. J. Chalmers; a Red-vented Bulbul (*Pycnonotus hamorrhous*) from India, presented by the Hon. Miss E. Dillon; a Chestnut-breasted Finch (*Donacola castanothorax*) from Queensland, presented by Mr. A. Rowney; a Hardwick's Mastigure (*Uromastix hardwicki*) from India, presented by Mr. W. Allen; a Black Swan (*Cygnus atratus*) from Australia, deposited; two Black-necked Stilt Plovers (*Himantopus nigricollis*) from South America, a Green-headed Tanager (*Calliste tricolor*) from South-east Brazil, purchased.

OUR ASTRONOMICAL COLUMN.

THE NEW COMETS.—Numerous observations of Perrine's Comet and a few of Comet Brooks are reported in *Ast. Nach.*, No. 3320. The former is generally described as bright, the nucleus being about 7th magnitude, while the tail is pretty broad, and variously estimated at from 10' to 20' in length. From observations up to November 25, Dr. E. Lamp finds the date of perihelion passage to be 1895, Dec. 18^h 35^m 09^s Berlin mean time, and the following ephemeris is given:—

	R.A.			Decl.	Bright- ness.
	h.	m.	s.		
Dec. 11 ...	15	59	40	−24 7'6	28'30
12 ...	16	16	14	26 2'1	
13 ...	34	33		27 50'5	
14 ...	16	54	40	29 25'0	
15 ..	17	16	5	−30 37'4	60'0

The unit of brightness is that on November 18. The comet is brightening with great rapidity, but it is so near the sun that observations can only be made in daylight.

Comet Brooks apparently presents only the appearance of a feeble, diffused nebulosity without condensation. The following ephemeris for Berlin midnight is due to Dr. H. Kreutz:—

	R.A.			Decl.	Bright- ness.
	h.	m.	s.		
Dec. 12 ...	7	16	42	+57 23'5	0'8
13 ...	7	0	37	59 45'8	
14 ...	6	43	39	61 48'0	0'6
15 ...	26	4		63 31'2	
16 ...	6	8	2	64 56'7	0'5
17 ...	5	49	52	66 6'2	
18 ...	31	47		67 1'4	0'4
19 ...	5	14	6	67 43'7	
20 ...	4	57	4	+68 15'0	0'3

The brightness on November 24 is taken as unity. According to the elements adopted, perihelion was passed on October 20th 1887.

It will be seen that the comet is now circumpolar.

THE GREAT COMET OF 1843.—In the *Astronomische Nachrichten*, No. 3320, Dr. Kreutz gives another chapter in the history of the three interesting comets of 1843 I., 1880 I., and 1882 II., all belonging to one cometary system, distinguished by great brilliancy and small perihelion distance. In 1889, Dr. Kreutz published an exhaustive monograph on the motion of the 1882 comet, that one of the system which, it will be remembered, was first seen in this country by Dr. Common, in bright daylight, and which at the Cape was followed till it seemed to touch

the sun's limb. The present inquiry has reference to the 1843 comet, also seen and observed in full daylight, and the motion of which had been made the subject of a classical discussion by Dr. Hubbard (*Astronomical Journal*, vols. i. and ii.). The improved normal places which Dr. Kreutz has formed are not, however, very well represented by Hubbard's orbit, and new elements have been derived, which, of course, do not differ materially from the earlier results. The period, deduced as the most probable, is 512 years, or twenty years less than Hubbard's period; but the interesting point in the present discussion is the determination of several orbits with various values for the semi-axis major, assigned on the hypothesis that this comet of 1843 is identical with some other the appearance of which has been recorded. The periods assigned are thirty-six years, suggested by a possible identity between the 1843 and 1880 comets; 175 years, which would make the 1843 comet a reappearance of that in 1668; 800 years, a period approximately equal to that found for 1882 II., and finally a parabolic orbit. The result is to settle very decisively that there is no identity between the 1843 and 1880 comets, and almost as certainly that the comet is not a return of that of 1668. On the other hand, it is by no means certain that equal periods would not satisfy the observations in both 1843 and 1882, but true parabolic motion cannot be accepted. From the position of the line of intersection of the orbital planes of the two comets 1843 and 1882, Dr. Kreutz infers that they originally formed one comet, and that the separation into two distinct bodies was effected near the time of perihelion passage. Seeing that the 1843 comet would approach within 100,000 miles of the sun's surface, it is easy to suggest a cause for the subdivision.

NEBULOSITIES AROUND THE PLEIADES.—The nebulous relationships of the Pleiades, brought so forcibly into view by the beautiful photographs of Dr. Isaac Roberts, are carried a stage further by a photograph which we owe to Prof. Barnard. This was taken with the 6-inch portrait lens with a total exposure of 10h. 15m. on December 6 and 8, 1893, and an enlargement and description of the plate are given in the current number of *Knowledge*. In this photograph the nebule photographed by Dr. Roberts are submerged in the "burnt out" images of the brighter stars; outside the group various nebulous masses and streams are seen extending in all directions, but apparently connected with the nebulosities of the cluster itself. The most prominent of the new nebulosities are two irregular streams flowing from the north and south sides of the cluster, and running three or four degrees easterly; the northern stream is double for a part of its length, but the upper part is very feeble. The nebulosities have also been photographed by Dr. Wilson, of the Goodsell Observatory, with an exposure of 11 hours; they are best seen by increasing the contrast in a positive copy of the plate.

THE FIRST STEPS IN SERUM-THERAPY.

IN scientific discovery, as in many other walks of life, it frequently happens that the magnitude of the result achieved casts into obscurity the labours which led up to that discovery, just as the parent is often forgotten in the same which may subsequently surround the work of his offspring. It is rarely, however, that so young an infant as we must perforce recognise antitoxic serum to be, succeeds in baffling the pedigree-hunter; barely recognised three or four years back, its parentage has, however, already become the subject of much discussion.

Dr. Welch, of Baltimore, in an exhaustive paper¹ on the treatment of diphtheria by anti-toxin, commences with an historical survey of the subject, and states that Babès and Lepp in 1889 were the first to publish results of experiments to solve the question whether the fluids and cells of animals which have been rendered immune by vaccination, have not become vaccines and capable of protecting also other organisms. On turning, however, to the volume of the *Annales de l'Institut Pasteur*, in which the memoir by Babès and Lepp² on this subject is published, we find that they do not claim to have originated these investigations, for they expressly state: "We have seen, in the course of our investigations, that this problem has been studied experimentally in various diseases, and this fact encouraged us to pursue this idea."

¹ "The Treatment of Diphtheria by Antitoxin," *Trans. Association of American Physicians*, vol. x., 1895.

² "Recherches sur la vaccination antirabique," *Annales de l'Institut Pasteur*, vol. iii., 1889.

In the address on Pasteur, delivered before the British Association at Ipswich, Prof. Percy Frankland distinctly attributes this discovery to Héricourt and Richet. He said: "This astounding antitoxic property of the blood-serum of an artificially immunised animal was first discovered by Héricourt and Richet in respect of animals immunised against one of the common abscess-producing organisms."¹

Now Dr. Welch goes out of his way in a foot-note reference to Babès and Lepp to mention that "Richet and Héricourt are sometimes quoted as the first experimenters to show that the blood of animals is capable of conferring protection upon susceptible animals, but their work has no reference to modern serum-therapy, as their experiments were made with the blood of dogs which had not previously been vaccinated or treated in any way."

If we refer to the *Comptes rendus* for 1888, we shall find a paper by Héricourt and Richet entitled "Sur un microbe pyogène et septique (*Staphylococcus pyosepticus*) et sur la vaccination contre ses effets." In this memoir the authors describe their experiments on procuring immunity in rabbits towards this organism by inoculating them with weakened cultures of it. They conclude by saying: "The methods which we have used to procure these vaccinations are those in general use by Pasteur and his pupils. But we have conceived of a new method (the peritoneal transfusion of a dog's blood into rabbits), a process which also produces vaccination; in a subsequent communication we shall describe in detail the results obtained by this method."

It is this subsequent paper which has been entirely overlooked by Welch and other investigators. Strange to say, also, there is absolutely no reference to it in the *Centralblatt für Bakteriologie*, although a very incomplete abstract of the earlier paper did appear in this journal. This second communication, to which, in the light of recent scientific investigations on the use of antitoxic serum, much interest and importance attaches, is entitled "De la transfusion péritonéale, et de l'immunité qu'elle confère" (*Comptes rendus*, 1888, p. 748).

The following passage, taken from this memoir, will perhaps most clearly convey some idea of what results were obtained by Héricourt and Richet in these first investigations in serum-therapy:—"On October 4, seven rabbits were inoculated with four drops of a culture of the *Staphylococcus pyosepticus*, six having received 48 hours previously some dog's blood in the peritoneum. The control animal² died in less than 20 hours after the inoculation. Of the six others, three died, one 50 hours, the other 70 hours, and the third 90 hours after the inoculation. The three others survived; they are still alive at the present time. To explain the apparent inconsistency of these results, it must be noted that the transfused blood was obtained from two different sources: first, from a dog which had never been experimented upon—the rabbits which received this blood did not survive the inoculation; secondly, from a dog which had survived inoculation made some months previously with the *Staphylococcus pyosepticus*: the three rabbits which received this blood survived the subsequent inoculation with the *Staphylococcus pyosepticus*." These results were confirmed by further investigations, proving, as the authors say, that it was not "un fait exceptionnel." In the course of their experiments Héricourt and Richet found that the blood of untreated dogs did endow rabbits with a certain degree of protection from subsequent inoculation with this micro-organism, inasmuch as the course pursued by the disease in the case of these rabbits was distinctly modified, being less virulent and less rapid, but they expressly state that they consider the assumption justified that the blood of dogs inoculated with this *Staphylococcus*, is capable of conferring immunity of a more complete nature than that obtained by using the blood from untreated dogs.

It is sufficiently apparent, therefore, that these experiments of Héricourt and Richet, far from having "no reference to modern serum-therapy," are the original investigations from which the antitoxic treatment of disease by means of blood-serum has directly followed.

The authors conclude this most interesting memoir by expressing the hope that the injection of the blood of an animal endowed with a natural power of resisting a particular disease may possibly be able to protect other animals, not so fortunately endowed, from attacks of this disease. So far, however, this hope has not been realised. In an article entitled "Recent Studies

on Diphtheria" (NATURE, August 22, 1895, p. 393), it was pointed out how the natural or race immunity of one animal to a particular disease was not capable of being transferred, by means of its blood-serum, to another animal susceptible to this disease. We read: "This remarkable circumstance has been once more very clearly demonstrated by Wassermann in the case of diphtheria, to which disease white rats are absolutely immune. In order to test the character of white-rat-serum as regards diphtheria infection, fatal doses of diphtheria toxin were administered to guinea-pigs along with such serum, but in no case did the latter survive, showing that this serum possessed no anti-diphtheric properties whatever, and was incapable of protecting animals from diphtheria infection."

In connection with the wider application of anti-toxic serum in the treatment of disease, it is interesting to note that already in 1889 Messrs. Babès and Lepp experimented with it successfully in the treatment of rabies, obtaining the anti-toxic serum from a dog rendered artificially immune to hydrophobia. So far, but little advance has been made with it in this direction; since, however, scientific attention has been so attracted to this subject by the success which has attended the use of anti-toxic serum in diphtheria, we may certainly anticipate many fresh developments in its beneficent application.

THE MAJOR PREMISS IN PHYSICAL CHEMISTRY.¹

CHEMISTRY is essentially an inductive science, mathematics is essentially deductive, while physics holds an intermediate position. Yet in our own science, generalisations are reached from time to time, which serve as major premisses for syllogistic reasoning. For example, the proposition that each portion of matter has constant weight is at the basis of our knowledge of chemical equivalents as determined by the balance; the isolation of the metals of the alkalis and alkaline earths led to an insight into the nature of salts in general as metallic compounds; and the "periodic law," though not expressed in precise mathematical language, is a most fruitful generalisation of generalisations.

Physical chemistry, following the logical methods already so largely adopted in physics, is characterised by a readiness to use the major premiss. Instead of making a separate experiment to answer each question of fact, the conclusion may often be reached on theoretical grounds, in the same sense as an engineer may demonstrate the stability of the structure he has designed, or the movements of a newly invented machine. What, then, is the leading major premiss in modern chemistry? and what shall be the conditions of fruitfulness?

The doctrine of energy, as based upon thermo-dynamics, embraces the two laws of conservation and correlation; first, energy (while convertible from one form to another) is constant in amount; second, while work may be wholly converted into heat, only a definite fraction of heat can be converted into work. To specify more clearly, if a quantity of heat, H , is received at temperature T (from absolute zero), and if this is converted into work as far as possible by any ideal process until there remains the quantity H' at temperature T' , then the simple theorem holds that the two quantities of heat are proportional to the two temperatures; and of course the difference between heat received and heat remaining (that is, the work) is proportional to the difference in temperature. Or in algebraic language,

$$\begin{aligned} H : H' &:: T : T' \\ H : H-H' &:: T : T-T' \\ \text{Work,} &= H-H' = \frac{T-T'}{T} \cdot H \end{aligned}$$

This equation shows what *fraction* of the heat may be converted into work, under the most favourable conditions; namely, the fall in temperature divided by the absolute temperature at which the heat is supplied.

My present purpose is to present this topic in its bare outlines, and with the greatest simplicity possible. Those who wish to follow the deductive reasoning in detail must use the notation of the calculus, in accordance with the following steps. Combining the formula for the total work (as implied in the first law) with that for work derived from change of temperature (the second

¹ Times Report, September 17, 1895.

² Not previously inoculated with dog's blood.

¹ Abstract of a paper prepared by request, to introduce the topic of Physical Chemistry, for the American Association for the Advancement of Science. Read September 2, 1895. (Reprinted from *Science*.)